Genetics: Part 1

Mendelian Genetics & Monohybrid Crosses

(Complete, Incomplete & Co-dominance)

Term 4 2011-12

Table 14.1 The Results of Mendel's F_1 Crosses for Seven Characters in Pea Plants [true breeding: itself = itself]

Character	Dominant Trait	×	Recessive Trait	F_2 Generation Dominant:Recessive	Ratio
Flower color	Purple	×	White	705:224	3.15:1
Flower position	Axial	×	Terminal	651:207	3.14:1
Seed color	Yellow	×	Green	6022:2001	3.01:1
Seed shape	Round	×	Wrinkled	5474:1850	2.96:1
Pod shape	Inflated	×	Constricted	882:299	2.95:1
Pod color	Green	×	Yellow	428:152	2.82:1
Stem length	Tall	×	Dwarf	787:277	2.84:1

GENETICS
Chapter 8

12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms.

Unit Must Knows	*Key Vocabulary*
1. Students will be able to understand the role of meiosis in genetics. a) Distinguish between dominant and recessive traits b) Understand Mendel's Law of Segregation and Independent Assortment and how it applies to genetic crosses **2. Students will be able to understand the concepts of genetic crosses.** a) Differentiate between genotype and phenotype. b) Explain the application of probability in predicting results of genetic crosses. c) Use a Punnett square to predict results of a monohybrid cross. d) Describe how a test cross is used to test the genotype of a dominant phenotype. e) Complete genetic problems involving incomplete dominance and codominance f) Differentiate between monohybrid and dihybrid crosses. **3. Students will be able to understand how scientists analyze human inheritance.** a) Use a karotype to determine a human genetic disorder. b) Analyze pedigrees to determine how genetic traits and how genetic disorders are inherited. c) Explain the inheritance of ABO blood groups.	• Genetics • Heredity • Trait • True-breeding • P generation • F_1 generation • F_2 generation • Dominant • Recessive • Law of segregation • Law of independent assortment • Allele • Genotype • Phenotype • Homozygous • Heterozygous • Probability • Monohybrid cross • Test cross • Incomplete dominance • Codominance • Dihybrid cross • Karyotype • Pedigree • Multiple alleles

Test Prep CheckList

Have I completed…

Key Terms…

- ☐ **Completed** and **know** all the Word Parts for this unit and the unit before?
- ☐ **Defined** and **studied** (flash cards help) the Key Terms for the Unit?

Reading Circles…

- ☐ **Completed** each of the reading circles for each of the sections in the book?
- ☐ **Taken** and **corrected** each of the Reading Quizzes for each section in the book?

Must Knows…

- ☐ **Identified** and have **written** the appropriate Must Know on the top of each page in the packet
- ☐ **Studied**, **Know** and **asked questions** for each of the Must Knows for this Unit.

Notes…

- ☐ **Taken** Cornell Notes for each day of the unit.
- ☐ **Generated** at least 5 questions for each page of notes.
- ☐ **Summary** is written for each page of notes

Organization…

- ☐ Everyday's Must Knows and Homework is written on the calendar or in an assignment notebook.
- ☐ Cornell Notes are stored in binder.

Unit 9 Genetics

Key Terms

Define the following…

Genetics

Heredity

Trait

True-breeding

P generation

F_1 generation

F_2 generation

Dominant

Recessive

Law of segregation

Law of independent assortment

Allele

Genotype

Phenotype

Homozygous

Heterozygous

Probability

Monohybrid cross

Test cross

Incomplete dominance

Codominance

Dihybrid cross

Karyotype

Pedigree

Multiple alleles

Bell Ringer Worksheet

Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	

Must Knows:

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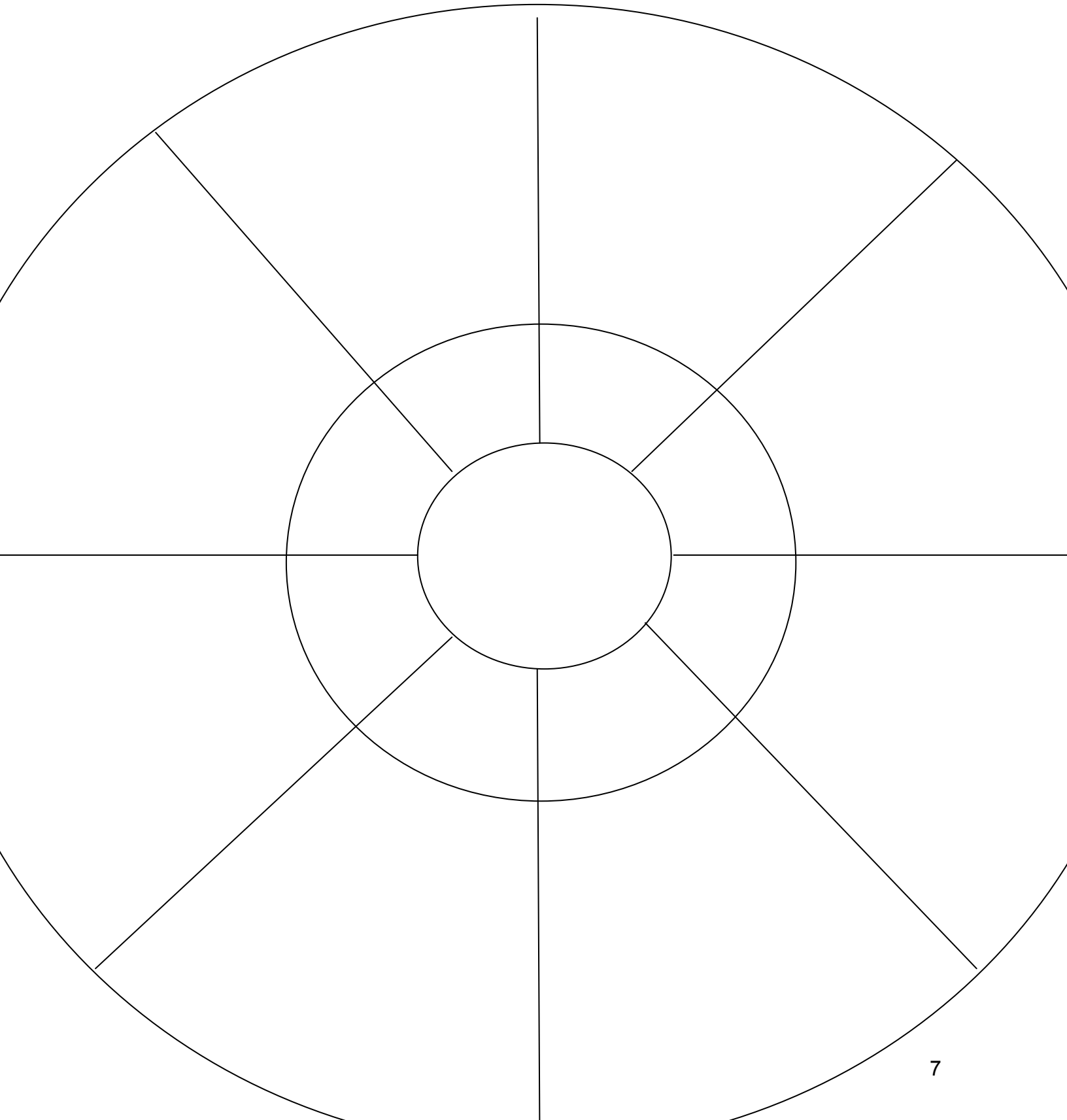

Must Knows:

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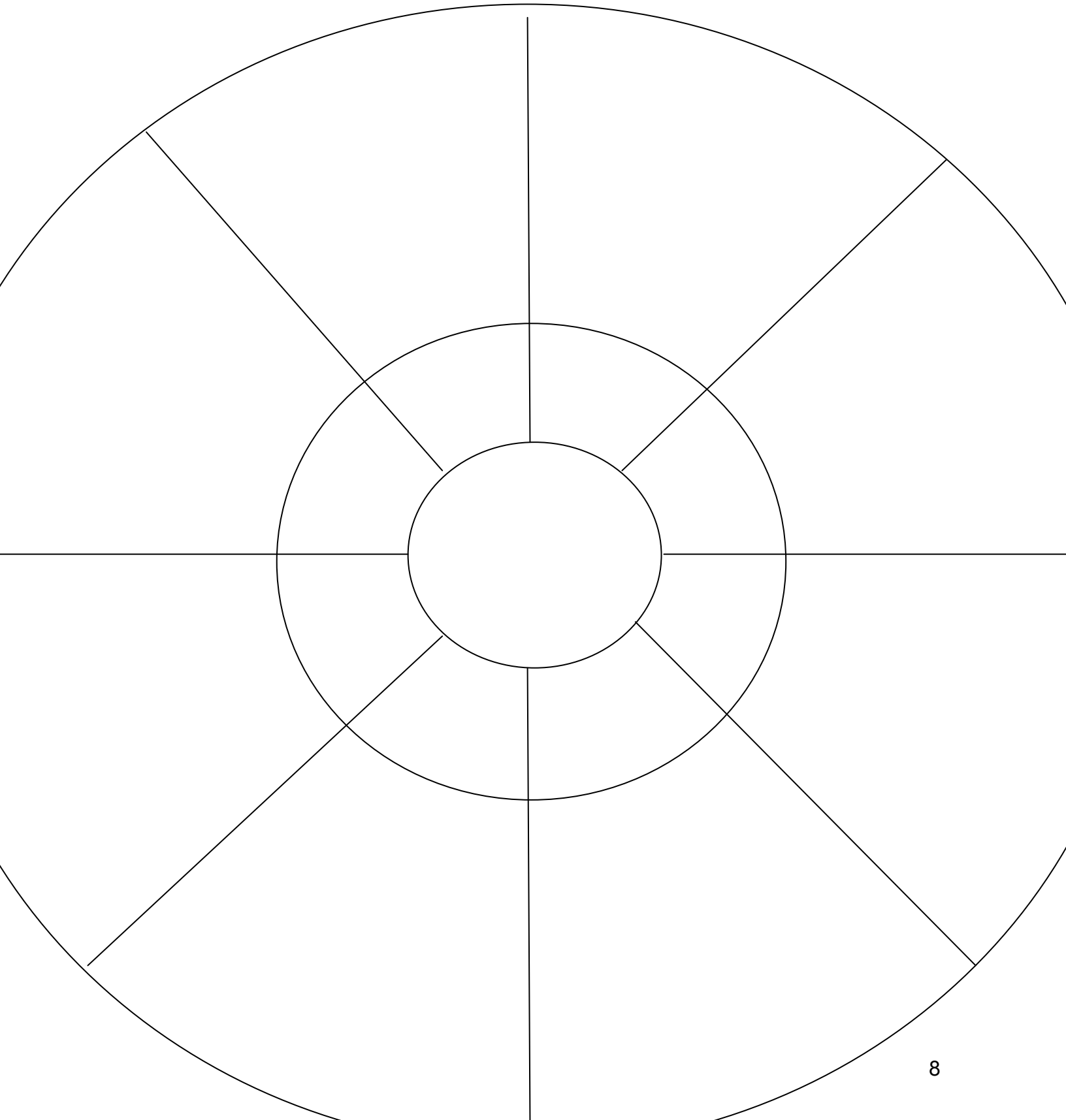

Must Knows:

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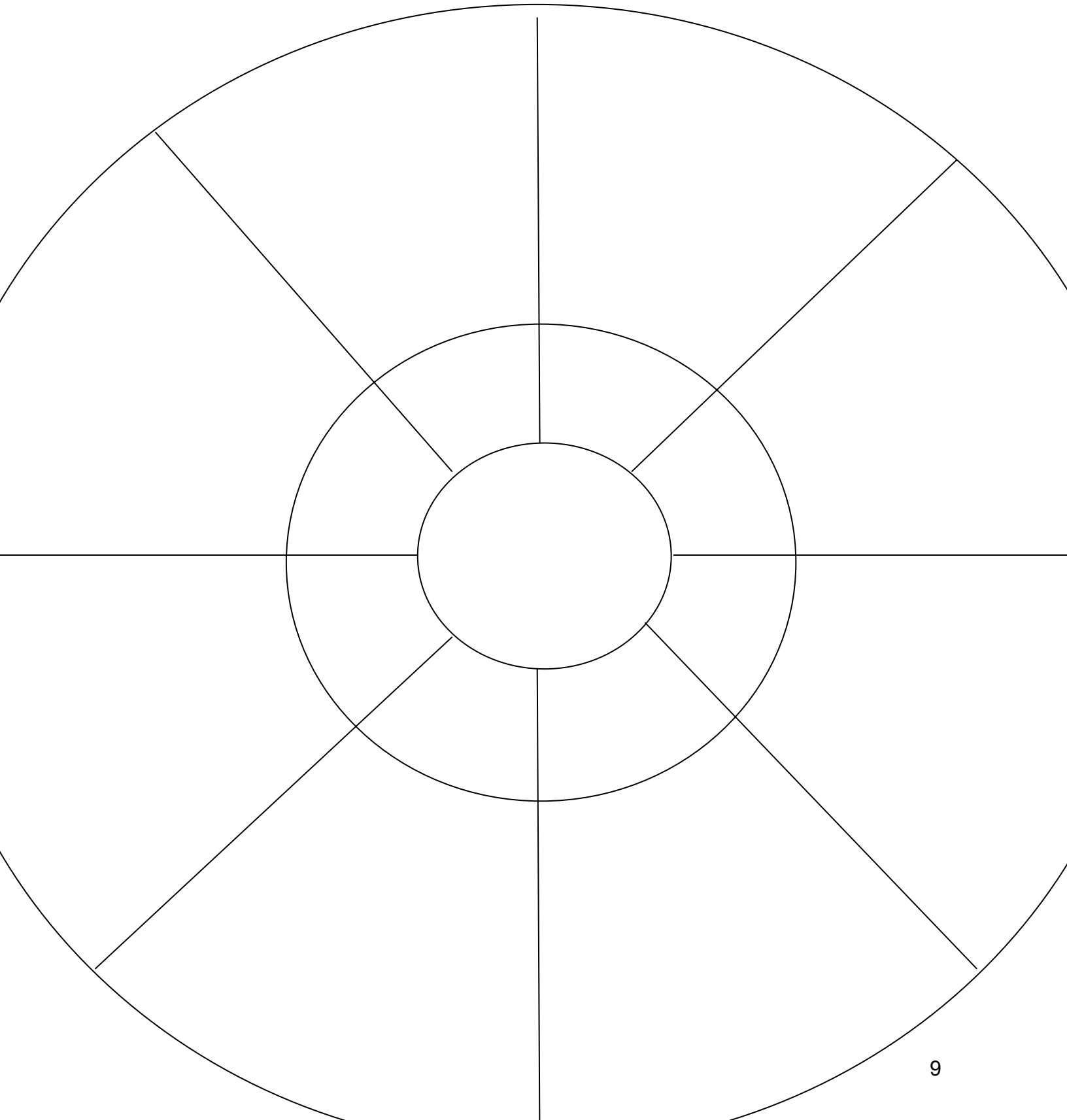

Must Knows:

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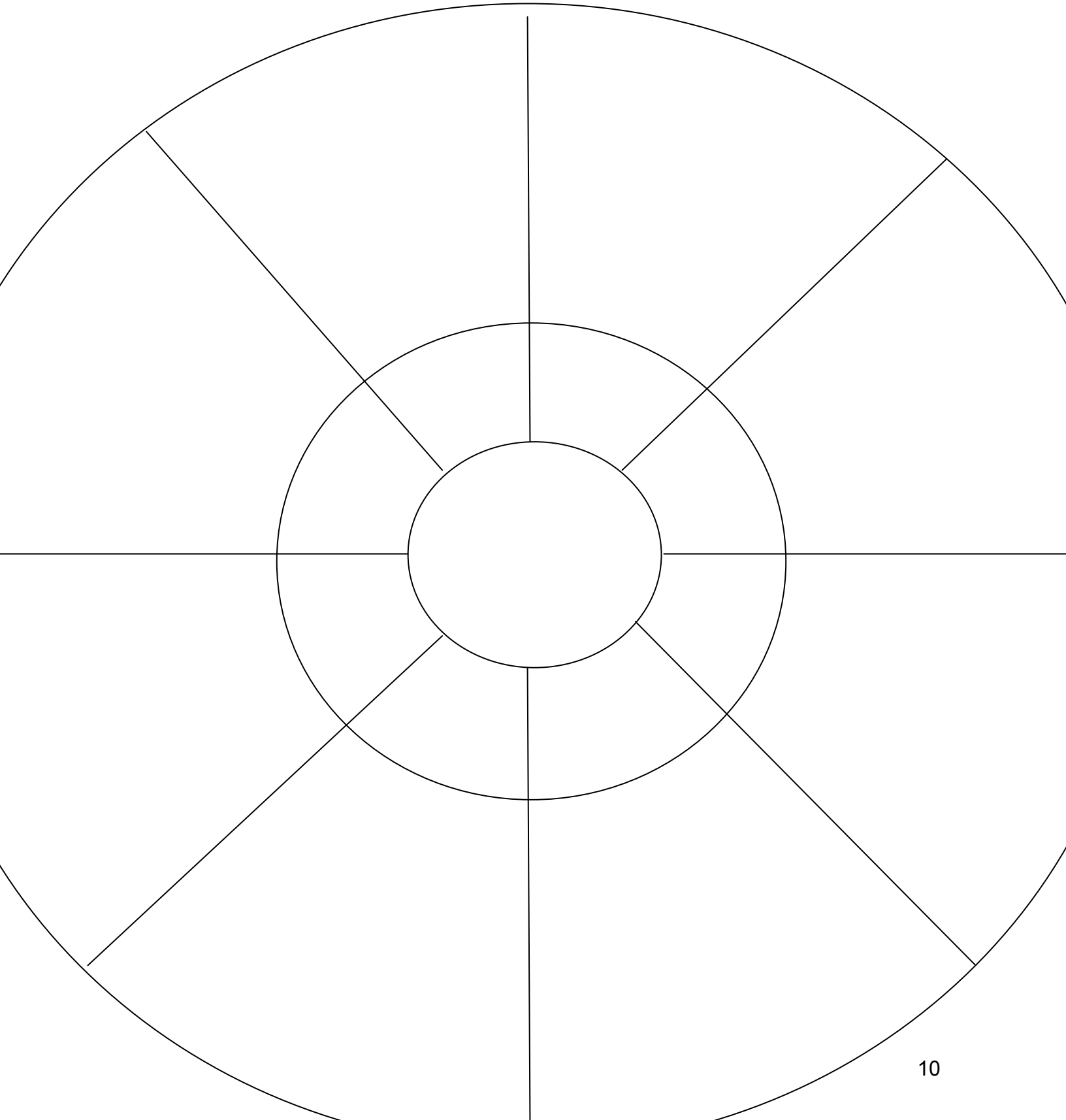


Cornell Notes	Topic/Objective:	Name:
AVID Decades of College Dreams		Class/Period:
		Date:

Essential Question:

Questions:	Notes:

Summary:

Cornell Notes	Topic/Objective:	Name:
AVID Decades of College Dreams		Class/Period:
		Date:

Essential Question:

Questions:	Notes:

Summary:

CHAPTER 12 MENDEL AND MEIOSIS

Review the Key Terms

Use the Chapter 12 key terms in the box below. Review the definitions of the terms. Then match each term with its definition by writing the letter of the term on the line provided.

a. genetics
b. fertilization
c. heredity
d. phenotype (FEE nuh tipe)
e. traits
f. genotype (GEE nuh tipe)

_____ **1.** when male and female gametes unite

_____ **2.** characteristics that parents pass on to their offspring

_____ **3.** passing on of traits to offspring

_____ **4.** study of heredity

_____ **5.** the appearance of a living thing

_____ **6.** the genetic makeup of a living thing

Use the Chapter 12 key terms in the box below. Review the definitions of the terms. Then use the terms to fill in the blanks in the sentences below. You will not use all the terms.

diploid (DIH ployd)	**crossing over**	**gametes (GAM eets)**
haploid (HAP loyd)	**meiosis (mi OH sus)**	**dominant**
heterozygous	**zygote (ZI goht)**	**pollination**
sexual reproduction	**genetic recombination**	
homologous chromosomes (hoh MAW luh gus • KROH muh sohmz)		

7. A cell with two of each kind of chromosome is called _____ .

8. _____ are sperm or egg cells.

9. A cell with one of each kind of chromosome is a(n) _____ cell.

10. _____ chromosomes have genes for the same traits in the same order on both chromosomes.

11. Parent cells make gametes in a process called _____ .

12. A(n) _____ is the cell created when a sperm enters an egg.

13. _____ _____ occurs when male and female gametes join to make a new living organism.

14. When nonsister chromatids exchange genes, it is called _____ _____ .

15. _____ _____ results in genetic variety.

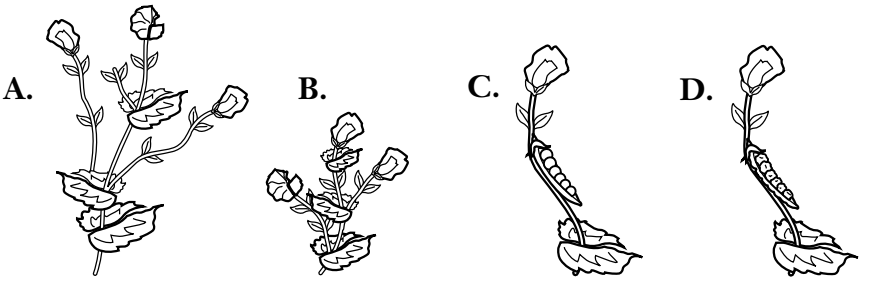
CHAPTER 12 MENDEL AND MEIOSIS

Section 12.1 Mendel's Laws of Heredity

Study the Diagrams

Use the diagram and the paragraph in the box to answer the questions.

Each of these pea plants has a different trait. Each trait is controlled by a pair of alleles that make up a gene for that trait. All genes of an organism make up a genotype. A genotype can be represented by its alleles. Letters such as ***T*** or ***t*** represent different alleles.



1. What are the genotypes of the plants in the diagram? The first one is filled in for you.

a. tall plant _____*TT*_____

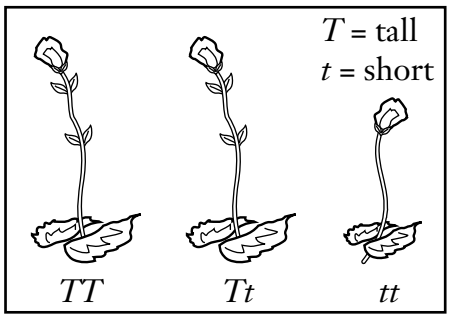
b. short plant _____

c. round pea _____

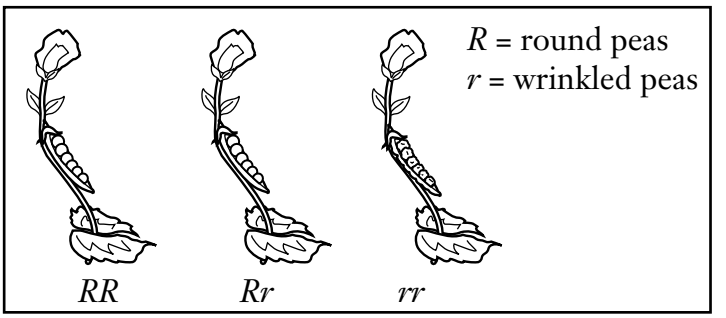
d. wrinkled pea _____

Use the diagrams and paragraph in the box to answer the questions.

A.



B.



The allele for tallness (*T*) makes two of the three plants in diagram A tall. The allele for tallness is a dominant allele. The trait with a dominant allele will show up over a trait with a recessive allele. This means that plants with the dominant allele for tallness will be tall even if they also have a recessive allele for shortness.

2. Will the peas in diagram B that have the genotype *Rr* be round or wrinkled? Explain your answer.

_____

3. In diagram B, what shape will the peas with the genotype *rr* have? Explain your answer.

_____

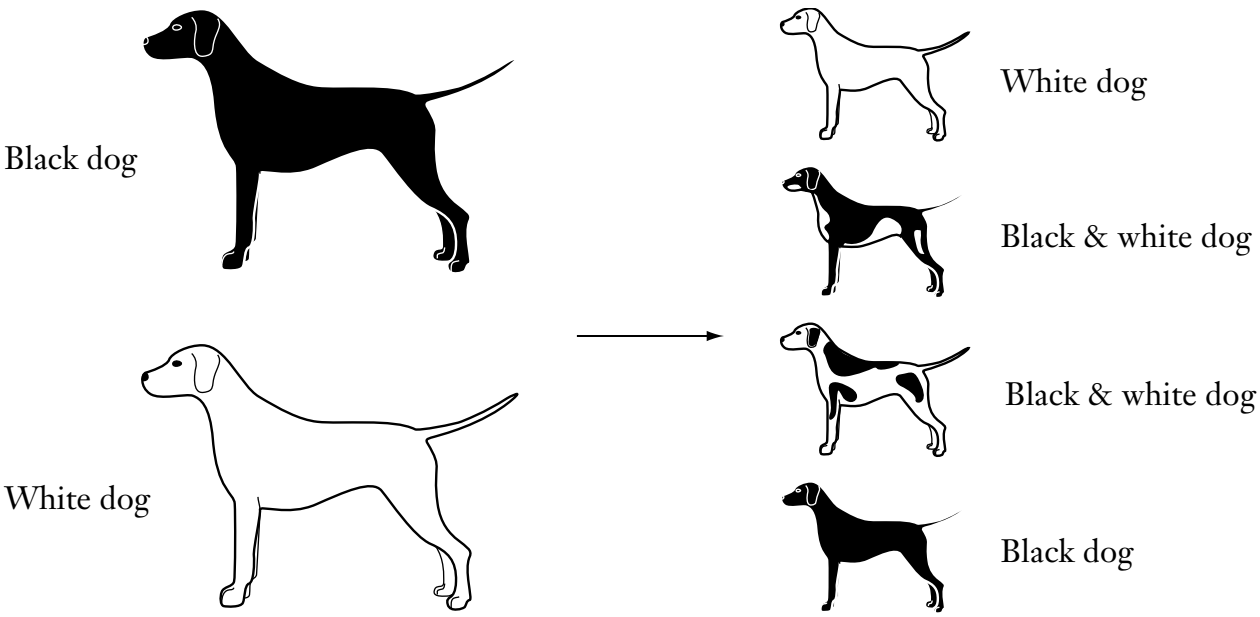
CHAPTER 12 MENDEL AND MEIOSIS

Get the Big Picture

What would the world be like if there were no meiosis? Think about it. Meiosis lets the genetic information from one cell combine with the genetic information from another cell to make a new and different cell. Without meiosis, all cells and organisms would be the same.

Gregor Mendel observed the results of meiosis for many years before he understood what he was seeing. He observed that tall plants came from short plants, wrinkled peas came from smooth peas, and much more. The process of the passing on of traits that results in a variety of offspring in each new generation is called **heredity**.

Study the picture and answer the questions.



1. What is heredity? _____

_____

_____

2. Why is meiosis important to the variety of life? _____

_____

_____

3. Are you the product of meiosis or mitosis? How can you tell? _____

_____

_____

Complete Dominance Punnett Square Worksheet

Complete the following monohybrid crosses: draw a Punnett square, list the ratio and describe the offspring. Be sure to remember that the **capital letter is dominant.**

Example

A green pea plant (GG) is being crossed with a green pea plant (Gg) yellow is the recessive color.

	G	G
G	GG	GG
g	Gg	Gg

Genotype = GG : Gg

Genotypic Ratio = 1 : 1

Phenotype = Green pea plants

Phenotypic Ratio = 4

1) A green pea plant (Gg) is crossed with a yellow pea plant (gg).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

2) A tall plant (TT) is crossed with a tall plant (Tt).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

3) A tall plant (Tt) is crossed with a short plant (tt).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

4) A red flower (Rr) is crossed with a white flower (rr).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

5) A white flower (rr) is crossed with a white flower (rr).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

6) A black chicken (BB) is crossed with a black chicken (BB).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

7. B= Brown eyes b= blue eyes Mom= Bb Dad= BB Brown eyes are dominant over blue eyes. What are the eye color possibilities if they chose to have children?

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

8. Curly hair is recessive, and straight hair is dominant. A woman with curly hair marries a man who is homozygous dominant for straight hair. Predict the outcomes for their children.

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

9. Black hair is homozygous dominant. Brown hair is heterozygous. Blonde hair is homozygous recessive. (This is an example of incomplete dominance.) A woman with brown hair marries a man with brown hair. What are the possible outcomes for their kids?

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

10. Attached earlobes are dominant over free hanging earlobes. Complete the Punnett Square for the following individuals: Mom=BB and Dad=bb

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

11. Freckles are recessive. No freckles are dominant.
Mom= heterozygous Dad=homozygous recessive Possible outcomes for kids?

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

12. A homozygous dominant brown mouse is crossed with a heterozygous brown mouse (tan is the recessive color).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

13. Two heterozygous white (brown fur is recessive) rabbits are crossed.

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

14. Two heterozygous red flowers (white flowers are recessive) are crossed.

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

15. A homozygous tall plant is crossed with a heterozygous tall plant (short is the recessive size).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

IncOMpleTe & COdominANce

In many ways Gregor Mendel was quite lucky in discovering his genetic laws. He happened to use pea plants, which happened to have a number of easily observable traits that were determined by just two alleles. And for the traits he studied in his peas, one allele happened to be dominant for the trait & the other was a recessive form. Things aren't always so clear-cut & "simple" in the world of genetics, but luckily for Mendel (& the science world) he happened to work with an organism whose genetic make-up was fairly clear-cut & simple.

If Mendel were given a mommy black mouse & a daddy white mouse & asked what their offspring would look like, he would've said that a certain percent would be black & the others would be white. He would never have even considered that a white mouse & a black mouse could produce a *GREY* mouse! For Mendel, the phenotype of the offspring from parents with different phenotypes always resembled the phenotype of at least one of the parents. In other words, Mendel was unaware of the phenomenon of INCOMPLETE DOMINANCE.

I remember Incomplete Dominance in the form of an example like so:
RED Flower x WHITE Flower ---> PINK Flower

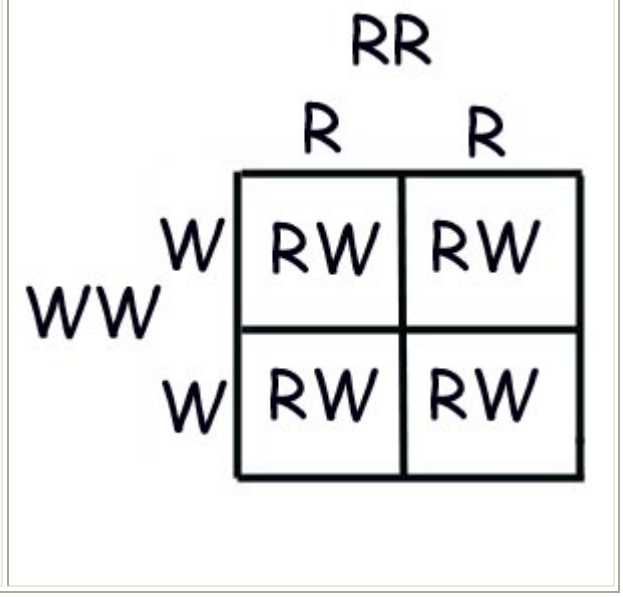
With incomplete dominance, a cross between organisms with two different phenotypes produces offspring with a third phenotype that is a blending of the parental traits.

It's like mixing paints, red + white will make pink. Red doesn't totally block (dominate) the white, instead there is *incomplete* dominance, and we end up with something in-between.

We can still use the Punnett Square to solve problems involving incomplete dominance. The only difference is that instead of using a capital letter for the dominant trait & a lowercase letter for the recessive trait, the letters we use are both going to be capital (because neither trait dominates the other). So the cross I used up above would look like this:

R = allele for red flowers
W = allele for white flowers

red x white --> pink
RR x WW ---> 100% RW



For a P-square "How To" click < here>.

The trick is to *recognize* when you are dealing with a question involving incomplete dominance. There are two steps to this:
1) Notice that the offspring is showing a 3rd phenotype. The parents each have one, and the offspring are different from the parents.
2) Notice that the trait in the offspring is a blend (mixing) of the parental traits.

Sample Questions

1. A cross between a blue blahblah bird & a white blahblah bird produces offspring that are silver. The color of blahblah birds is determined by just two alleles.

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

2. The color of fruit for plant "X" is determined by two alleles. When two plants with orange fruits are crossed the following phenotypic ratios are present in the offspring: 25% red fruit, 50% orange fruit, 25% yellow fruit. What are the genotypes of the parent orange-fruited plants?

Codominance Problems

First let me point out that the meaning of the prefix "co-" is "together".
Cooperate = work together. Coexist = exist together. Cohabitat = habitat together.

The genetic gist to codominance is pretty much the same as incomplete dominance. A hybrid organism shows a third phenotype --- not the usual "dominant" one & not the "recessive" one ... but a third, *different* phenotype. With incomplete dominance we get a blending of the dominant & recessive traits so that the third phenotype is something in the middle (red x white = pink).

In COdominance, the "recessive" & "dominant" traits appear together in the phenotype of hybrid organisms.

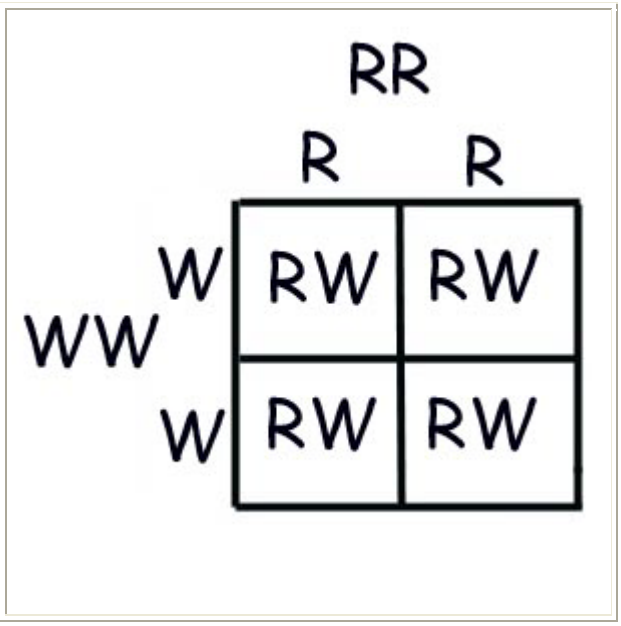
I remember codominance in the form of an example like so:
red x white ---> red & white spotted

With codominance, a cross between organisms with two different phenotypes produces offspring with a third phenotype in which both of the parental traits appear together.

When it comes to punnett squares & symbols, it's the same as incomplete dominance. Use capital letters for the allele symbols. My example cross from above would look like so:

R = allele for red flowers
W = allele for white flowers

red x white ---> red & white spotted
RR x WW ---> 100% RW



A very very very very very common phenotype used in questions about codominance is roan fur in cattle. Cattle can be red (RR = all red hairs), white (WW = all white hairs), or roan (RW = red & white hairs together). A good example of codominance.

Another example of codominance is human blood type AB, in which two types of protein ("A" & "B") appear together on the surface of blood cells.

Sample Questions

1. Predict the phenotypic ratios of offspring when a homozygous white cow is crossed with a roan bull.

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

2. What should the genotypes & phenotypes for parent cattle be if a farmer wanted only cattle with red fur?

3. A cross between a black cat & a tan cat produces a tabby pattern (black & tan fur together).

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

Punnett Squares – Incomplete Dominance!

1. Palomino horses exist as a result of **incomplete** dominance. A horse can be chestnut brown (dominant), creamy white (recessive), or pale brown with a white tail and mane (therefore, palomino). What would the genotypes and phenotypes of the potential offspring of a palomino and a chestnut brown horse?

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

2. Andelusian fowls exhibit **incomplete** dominance for the color of their feathers. The color could be mottled gray, white (dominant), or black (recessive). What are the phenotypes of potential offspring of a gray and black parent set?

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

3. Hair type (straight - dominant, wavy, or curly - recessive) is a trait determined by incomplete dominance. If two parents have wavy hair, what are the genotypes and phenotypes of their potential offspring? What is the probability for straight hair?

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

4. Incomplete dominance problem: T=tall (5’11”-6’2”); TS=medium height (5’4”-5’10”)
   S=short (5’3” or smaller)

   Mom= 5’5”
   Dad= 6’0” What are the possible height outcomes of their children?

Genotypes

Genotypic Ratio

Phenotypes

Phenotypic Ratio

Name_____

II. **Incomplete Dominance** or Blending

Description: In some organisms, an individual displays a trait that is **intermediate** between the two parents, a phenomenon known as **incomplete dominance**. For example, the inheritance of flower color in snapdragons does not follow Mendel's idea of dominance. A cross between a snapdragon with red flowers and one with white flowers produces a snapdragon with pink flowers. The flowers appear pink because they have less red pigment than the red flowers. In humans this can happen when a trait for curly hair and straight hair appear together--the hair will be wavy.

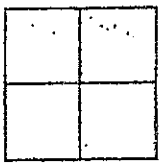
II. Predict the Genotypes and Phenotypes of the offspring between the following snapdragon plants:

Key: R = Red
W= White
RW = Pink (both capital letters to show blending)

A. Red Plant and a White Plant

Parents:

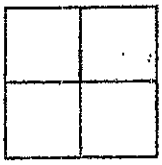
Genotypes of offspring: Phenotypes



B. Pink Plant and a White Plant

Parents:

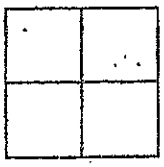
Genotypes of offspring: Phenotypes



C. Two pink plants

Parents:

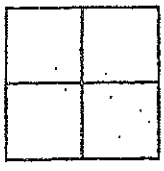
Genotypes of offspring: Phenotypes



D. Red Plant and a Pink Plant

Parents:

Genotypes of offspring: Phenotypes



III. Codominance:

Description: In some cases, two **dominant alleles are expressed at the same time**, a phenomenon called **codominance**. Codominance is different because both traits are displayed. An example of codominance is the roan coat in horses. A cross between a homozygous red horse and a homozygous white horse results in heterozygous offspring with a roan coat, which consists of red hairs and white hairs. Key: RR=Red WW=White RW=Roan (All capitals to show codominance)

A. Red Horse and a White Horse

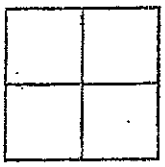
Parents:

Genotypes of offspring: Phenotypes

B. Roan Horse and a White Horse

Parents:

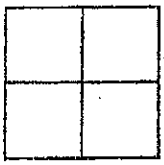
Genotypes of offspring: Phenotypes



C. Two Roan Horses

Parents:

Genotypes of offspring: Phenotypes



D. Red Horse and a Roan Horse

Parents:

Genotypes of offspring: Phenotypes